* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the polymer excellent in the secondary nonlinear optical property acquired by making the India aniline derivative and a 2 organic-functions epoxy resin with an amino group react.
[0002]Although optical communications are put in practical use from the necessity of processing a lot of information promptly, the electrooptics device which controls light electrically in future optical communications is expected to play a central role.
[0003]This principle of operation uses the Pockels effect to which change of a refractive index is proportional to primary [of an electric field], and the optical polariscope, the optical switch, the optical modulator, etc. are made using this effect.
[0004]Although a Pockels effect can be seen about the inorganic crystal of lithium niobate ($LiNbO_3$), lithium tantalate ($LiTaO_3$), etc. without inversion symmetry and device formation is carried out by ****, A dielectric constant is large in addition to an electro-optic constant not being so large as it, and there is a problem referred to as being unable to respond in improvement in the speed of a signal.
[0005]Then, an organic compound crystal like [a dielectric constant is low and] a methylnitroaniline or urea as a material in which a nonlinear optical effect is shown attracted attention. However, easily, these organic crystals are weak and treatment has a problem of ****, thin-film-being hard toize.
[0006]Then, its attention is paid to organic high polymer nonlinear material without such a problem.
[0007]
[Description of the Prior Art]There is a distributed electric field orientation polymer which added the polar molecule into the polymer material as an organic nonlinear optical material and to

which orientation of the electric field was added and carried out in the state where it distributed.

[0008]Thin-film-izing is possible for this polymer, it is simple for a membrane formation process, has ****** which has the feature of being able to form cheaply, and a problem referred to as that a nonlinear optical effect is gradually lost by orientation relaxation, and needs to control orientation relaxation.

[0009]There is an example over which the epoxy resin was made to construct a bridge by diamine with a nonlinear optical effect as a polymer which controlled orientation relaxation. (M. Eich etc.: Since the wt. ratio of the epoxy resin in which J Appl.Phys. 66, 3241-1989), however a nonlinear optical effect are not shown was large, there was a problem which says that an effect does not become large.

[0010]

[Problem(s) to be Solved by the Invention]Although the distributed electric field orientation polymer to which orientation of the electric field was added and carried out is studied making the copolymerization polymer which contains a polar molecule as a material in which a secondary nonlinear optical effect is shown, and heating this polymer to the temperature more than glass transition temperature, the material where whose electro-optic constant was high enough, and was stabilized is not found out.

[0011]Then, an electro-optic constant is high enough, and it is a technical problem to put in practical use the distributed electric field orientation polymer which orientation relaxation does not produce easily.

[0012]

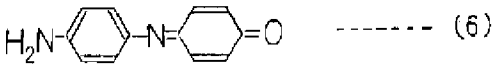
[Means for Solving the Problem]The India aniline derivative in which the above-mentioned technical problem has an amino group, A mixture with 2 organic-functions epoxy resins, such as a bisphenol A epoxy resin, a biphenyl epoxy resin, phenyl diglycidyl ether, and naphthyl diglycidyl ether, impressing an electric field. It is solvable by constituting an organic nonlinear optical material by being characterized by being obtained by carrying out a heating polymerization.

[0013]

[Function]This invention carries out the heating polymerization of the mixture of the India aniline derivative with an amino group, and a 2 organic-functions epoxy resin, impressing an electric field, or it carries out vapor deposition polymerization of the two ingredients, impressing an electric field, and forms an electric field orientation polymer.

[0014]Since such a polymer takes the structure which the India aniline derivative which has a nonlinear optical effect in the boundary part of the polymer chain which an epoxy resin forms combines in the form of a side chain, a nonlinear optics molecule does not deposit as a crystal.

[0015]Molecular polarizability (beta) which the India aniline derivative concerning this invention bears the great portion of nonlinear optical effect manifestation, and is an index of a secondary nonlinear optical effect for that purpose A large enough thing is required.
[0016]Then, it is molecular polarizability (beta) about the India aniline derivative which is a typical material of the India aniline derivative with an amino group, and is expressed with a general formula (6). It asked and compared with the PARANITORO aniline known as a fundamental nonlinear optics molecule.
[0017]
[Formula 6]



(6)

as a result, the molecular polarizability (beta) of India aniline expressed with a general formula (6) was $52x10^{-30}$ esu, compared with $8x10^{-30}$ esu of PARANITORO aniline, it could be markedly alike, and the large thing was able to be confirmed.
[0018]Since a secondary nonlinear optical effect is not produced by a substance with inversion symmetry, In order to negate the inversion symmetry of a polymer, when carrying out heat cure of the mixture, it is necessary to perform an electric field orientation and to arrange the dipole moment of the molecule which produces a nonlinear optical effect, and there are a method of performing by making a mixture intervene between parallel poles and a method of using corona electrical charging as an electric field impressing method, but. Even if it uses which method, it can carry out easily.
[0019]When performing vapor deposition polymerization, there are a method of providing the parallel pole of a couple in a vacuum evaporation board, and impressing voltage to it, and a method of using a substrate as one electrode, providing a lattice-like electrode in this upper part, and impressing an electric field at right angles to a substrates face, and even if it uses which method, an electric field orientation can be performed.
[0020]
[Example]
Example 1 : (claim 2 correspondence)
The India aniline expressed with a general formula (6) as an India aniline derivative with an amino group was mixed by the equivalent ratio of 1:1 again using the bisphenol A epoxy resin expressed with a general formula (2) as a 2 organic-functions epoxy resin.
[0021]It is this mixture in N.N-dimethylformamide (abbreviated to DMF) 150 ** and 50 After carrying out the time reaction and performing an addition reaction, it refined through the filter of 0.2 mum as a 30%DMF solution of a polymer.
[0022]Next, gold (Au) was vapor-deposited on the glass substrate, using photo-etching art (photolithography), on the glass substrate which carried out pattern formation of the parallel

pole with the electrode spacing of 10 micrometers, the spin coat of this solution was carried out on the conditions for 30 seconds at 1000 rpm, and resin was covered in thickness of 2 micrometers.

[0023]Next, after heating this substrate at 80 ** for 1 hour, it was neglected for two days and made to dry in a vacuum. Next, it was made to harden, having heated for 2 hours and carrying out an electric field orientation by 100 **, impressing the voltage of 500 V to inter-electrode, it lowered to the room temperature on condition of for 4 ** of ****/which impressed voltage after the end of hardening, and orientation was finished.

[0024]Next, measurement of an electrooptic effect puts a sample on a Mach Zender type interferometer, The method (M. : besides Sigelle J.Appl.Phys.52-4199, 1981 statements) of detecting the refractive index change of a sample when an electric field is impressed from intensity change of an interference light is used, That value was 30 pm/V although it asked for the electro-optic constant by comparison with this sample using $LiNbO_3$ whose electro-optic constant r_{33} is 30 pm/V as a reference sample using the helium-Ne laser whose wavelength is 632.8 nm as a light source.

Example 2 : (claim 3 correspondence)

The India aniline expressed with a general formula (6) as an India aniline derivative with an amino group was mixed by the equivalent ratio of 1:1 again using the tetramethyl kana phenyl epoxy resin expressed with a general formula (7) as a 2 organic-functions epoxy resin.

[0025]The value was 32 pm/V, although carried out the spin coat on the glass substrate like Example 1 hereafter, and it was made to harden, making and carrying out the electric field orientation of the resin layer, the polymer was made and it asked for the electro-optic constant in the similar way.

Example 3 : (claim 4 correspondence)

The India aniline expressed with a general formula (6) as an India aniline derivative with an amino group was mixed by the equivalent ratio of 1:1 again using the phenyl diglycidyl ether expressed with a general formula (4) as a 2 organic-functions epoxy resin.

[0026]The value was 33 pm/V, although carried out the spin coat on the glass substrate like Example 1 hereafter, and it was made to harden, making and carrying out the electric field orientation of the resin layer, the polymer was made and it asked for the electro-optic constant in the similar way.

Example 4 : (claim 5 correspondence)

The India aniline expressed with a general formula (6) as an India aniline derivative with an amino group was mixed by the equivalent ratio of 1:1 again using the naphthyl diglycidyl ether expressed with a general formula (5) as a 2 organic-functions epoxy resin.

[0027]The value was 32 pm/V, although carried out the spin coat on the glass substrate like Example 1 hereafter, and it was made to harden, making and carrying out the electric field

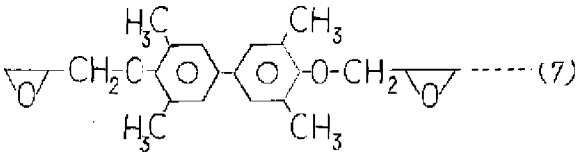
orientation of the resin layer, the polymer was made and it asked for the electro-optic constant in the similar way.

Example 5 : (claim 6 correspondence)

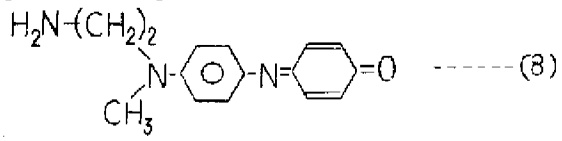
The inside of a vacuum evaporator was decompressed to 10^{-6}torr using the tetramethyl biphenyl epoxy resin expressed with a general formula (7) as a 2 organic-functions epoxy resin again in the India aniline expressed with a general formula (8) as an India aniline derivative with an amino group.

[0028]

[Formula 7]



[Formula 8]



While the parallel pole (electrode spacing of 10 micrometers) of aluminum (aluminum) kept substrate temperature at 30 ** and impressed 200 V to inter-electrode by **** using the quartz substrate which has carried out pattern formation as a vacuum evaporation board, performed vapor deposition polymerization, and asked for the electro-optic constant like Example 1 about this sample, but. The value was 30 pm/V.

Comparative example 1: PARANITORO aniline was mixed with the bisphenol A epoxy resin by 1:1 equivalent ratio, and after processing a part for 140 ** and 30 and making this mixture into a prepolymer, it dissolved in N,N-dimethylformaldehyde, was considered as the solution 20%, and refined through the filter of 0.2 mum.

[0029]And although it asked for the electro-optic constant by the same method as Example 1, the value was 4 pm/V and few values.

[0030]

[Effect of the Invention]Heat cure is carried out in this invention, carrying out electric field impression of the mixture which consists of an India aniline derivative with an amino group, and a 2 organic-functions epoxy resin.

Therefore, an electric field orientation type nonlinear polymer with a large nonlinear optical effect can be obtained.

[Translation done.]